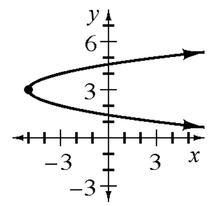
Lesson 12.1.1

12-6. a: 4050; b: 300 + 550 + 800 + … + 4050, $300+250n$

12-7. a: $7n-4$, b: $29-9n$

12-8. –2

12-9. $x=2(y-3)^2-5$, vertex: (–5, 3), graph shown at right



12-10. x^3-2x^2-3x+9

12-11. a: $8+12i$, b: $-\frac{5}{13}+\frac{12}{13}i$

12-12. a: $\frac{ad+bc}{bd}$, b: $\frac{adf+bcf+bde}{bdf}$

12-13. They are equivalent and simplify to x^2.

12-14. a: –5, 4; b: 5, –8

12-15. Possible answers include $\cos\frac{3\pi}{4}=-\frac{\sqrt{2}}{2}$, $\cos\frac{5\pi}{4}=-\frac{\sqrt{2}}{2}$, and $\cos\frac{7\pi}{4}=\frac{\sqrt{2}}{2}$.

12-16. 80°, ≈ 19.8 feet, ≈ 39.0 feet

12-17. 34,800

12-18. Yes, because the sum of the diameters is 830 mm.

12-19. 235

12-20. $(-6)+(-3)+0+3+6+9+12+15+18$

12-21. It is the 55th term.

12-22. a: $\frac{1}{12}$, b: $\sqrt{580}$, c: (–9, 1), d: $y-2=\frac{1}{12}(x-3)$

12-23. $h(t)=-16t^2+80t+6$

12-24. a: $2(3x+2)(4x-5)$, b: $(4x^2+1)(2x+1)(2x-1)$

12-25. a: $x\neq 0$, b: $y>0$, c: $x=\pm\frac{1}{2}$, d: $x<-\frac{1}{2}$ or $x>\frac{1}{2}$

Lesson 12.1.2

12-34. a: odds: $t(n)=2n-1$, evens: $t(n)=2n$; b: odds: 5625, evens: 5700

12-35. a: $25-4n$, b: 31 terms (you can solve the equation $25-4n=-99$), c: –1209

12-36. $(x+1)$, $(3x-2)$, $(x-3)$

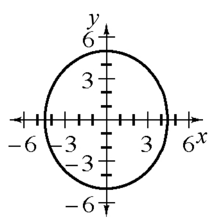
12-37. a: $-2i$, b: $-2-2i$

12-38. a: $\frac{b^9}{27}$, b: $x^{3/2}$ or $x\sqrt{x}$

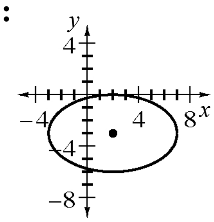
12-39. a: ≈ 5.97, b: $-\frac{9}{20}$

12-40. Possible answers include $\sin\frac{2\pi}{3}=\frac{\sqrt{3}}{2}$, $\sin\frac{4\pi}{3}=-\frac{\sqrt{3}}{2}$, and $\sin\frac{5\pi}{3}=-\frac{\sqrt{3}}{2}$.

12-41. a:



b:



12-42. 12! = 479,001,600

Lesson 12.1.3

12-49. a: 16,200, b: 16,040, c: 564

12-50. $11+22+33+...+99=495$

12-51. a: Sample response: The terms decrease by two, then add seven, than decrease by two and then add seven continually.
b: It is not arithmetic, because the difference from one term to the next is not constant.
c: Find the sum of each "unzipped" series and then add these sums together. The sum is 32,240.

12-52. $y=-2(x+2)^2(x-2)$

12-53. a: $x=17$, b: $x=-\frac{1}{2}$, c: $x=2$, d: $x=4$

12-54. $x=7$

12-55. a: $210^\circ, 330^\circ$; b: 180°

12-56. $(13, -6)$

12-57. $-3 \pm \sqrt{\frac{17}{2}} \cdot \sqrt{\frac{2}{2}} = -3 \pm \frac{\sqrt{34}}{2} = \frac{-6 \pm \sqrt{34}}{6}$; one possibility: $g(x) = 2x^2 + 12x + 1$

12-58. a: $\frac{x^2}{9} + \frac{y^2}{36} = 1$, b: $\frac{x^2}{5} + \frac{y^2}{1} = 1$

12-59. a: $\approx 5.48 \cdot 10^{26}$, b: $\approx 7.30 \cdot 10^{24}$, c: ≈ 0.013

Lesson 12.1.4

12-64. a: $\sum_{k=1}^{11} (60 - 13k) = -198$, b: $\sum_{k=1}^{n} (7k - 4) = \frac{n(7n-1)}{2}$

12-65. 495,550

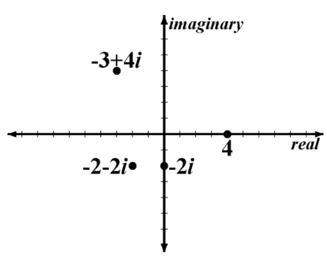
12-66. a: $\frac{k(k+1)}{2} + k + 1 = \frac{k^2+k}{2} + \frac{2k}{2} + \frac{2}{2} = \frac{k^2+3k+2}{2} = \frac{(k+1)(k+2)}{2}$

b: $\frac{k(7k-1)}{2} + 7(k+1) - 4 = \frac{7k^2-k}{2} + \frac{14(k+1)}{2} - \frac{8}{2} = \frac{7k^2-k+14k+14-8}{2} = \frac{7k^2+13k+6}{2} = \frac{(k+1)(7k+6)}{2}$

12-67. It works for the integers from 1 through 39. Students are likely to think that they have proven it by testing it for some number of values.

12-68. a: $7 \cdot 3^n$, b: $10(0.6)^{n-1}$

12-69.



a: 2, b: 5, c: $\sqrt{8}$ or $2\sqrt{2}$, d: 4

12-70. It is between 2 and 4, since $1 < \log 50 < 2$. $10^1 = 10$ and $10^2 = 100$.

12-71. $(0, 0)$

12-72. a: The domain is all real numbers except $\frac{\pi}{2} + \pi n$, the first (positive) asymptote is at $x = \frac{\pi}{2}$, and they repeat every π radians after that.

b. Shift the original graph $\frac{\pi}{2}$ radians to the right.

c. Yes, the first asymptote is now located at $x = 0$ and repeats every π radians after that, making the domain all real numbers except πn. The range of both functions is all real numbers and is not affected by a horizontal shift.

12-73. $x > 1$

12-74. $\frac{(x-4)^2}{36} + (y+3)^2 = 1$

12-75. a: ${}_{10}C_2 = 45$, b: ${}_{10}C_3 = 120$

Lesson 12.2.1

12-82. $\frac{3k^2+7k}{2} + 3k + 5 = \frac{3k^2+7k}{2} + \frac{6k}{2} + \frac{10}{2} = \frac{3k^2+13k+10}{2}$

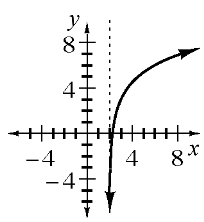
12-83. 506

12-84. $\sum_{n=1}^{10}(2n) = 110$

12-85. $7 + 14 + 21 + ... + 497 = 35{,}784$

12-86. a: $3x(x-6)$, b: $(k+1)(3k+10)$, c: $(2m-5)(3m+1)$, d: $(3t-5)(3t+5)$

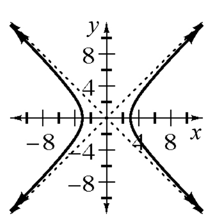
12-87.



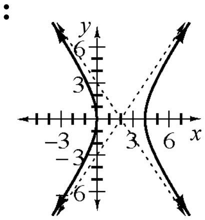
12-88. possible answer: $y = x^4 - 2x^3 - 8x^2 + 10x + 15$

12-89. Since $\tan\theta = \left(\frac{\sin\theta}{\cos\theta}\right)$, $\tan\left(\frac{7\pi}{6}\right) = \frac{-\frac{1}{2}}{-\frac{\sqrt{3}}{2}}$, which simplifies to $\frac{1}{\sqrt{3}}$ or $\frac{\sqrt{3}}{3}$.

12-90. a:



b:



12-91. 25

12-92. 2(5!)(3!) = 1440

12-93. $k(2k+9) + 4(k+1) + 5 = 2k^2 + 11k + 9 = (k+1)(2(k+1)+7)$

12-94. a: She proved that $3+6+9+...+3n = \frac{3}{2}n(n+1)$ is true for all integers $n \geq 2$.
b: She could have verified that the relationship was true for $n=1$ instead of $n=2$.

12-95. a: –338, b: –8325

12-96. sample answers: $\sum_{v=1}^{6} 3v-2$ or $\sum_{h=0}^{5} 1+3h$

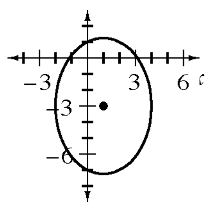
12-97. a: $2\cdot 5^n$, b: $1000(0.3)^{n-2}$ or $300(0.3)^{n-3}$, c: $2(\frac{1}{3})^{n-4}$, d: ar^{n-1}

12-98. a: $x > 1000$, b: $0 < x < 10$, c: $x > 2$, d: $0 < x < 1$ or $1 < x < 3$

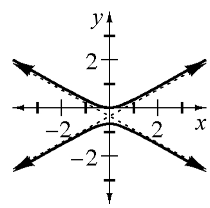
12-99. (±4, 3), (±3, –4)

12-100. a: $\frac{-\sqrt{2}}{2}$, b: $\sqrt{3}$, c: $-\frac{1}{2}$

12-101. a: ellipse, $\frac{(x-1)^2}{9} + \frac{(y+3)^2}{18} = 1$, (1, –3)



b: hyperbola, $\frac{(y+2)^2}{4} - \frac{x^2}{12} = 1$, (0, –2)



12-102. ${}_8C_3 \cdot {}_{10}C_3 = 6720$

12-103. $\frac{{}_4C_1 \cdot {}_6C_1 \cdot {}_2C_1}{{}_{12}C_3} = \frac{12}{55}$

Lesson 12.3.1

12-119. a: $3+30+300+3{,}000+30{,}000+300{,}000=333{,}333$
b: Write the series $3+30+...+300{,}000=S(6)$ twice. Multiply one of them by 10. Subtract $10S(6)-S(6)=2{,}999{,}997=9S(6)$. Divide by 9 to get 333,333.
c: $\sum_{n=1}^{n} 3\cdot 10^n = \frac{3\cdot 10^n - 3}{9}$

12-120. a: A sequence would represent the list of the class sizes of the graduating classes as the number of years since the school opened increased. The corresponding series would represent the growing number of alumni.
b: $t(10)=150$; total = 960
c: $n(36+6n)=36n+6n^2$

12-121. a: 15, b: –615

12-122. 210, arithmetic

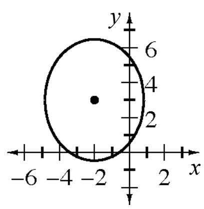
12-123. possible answer: $y = x^4 - 4x^3 + 2x^2 - 4x + 1$

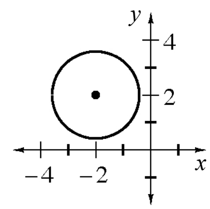
12-124. a: $x \approx 4.505$, b: $x \approx 5.921$

12-125. a: $\frac{\sqrt{2}}{2}$; b: $\frac{-\sqrt{2}}{2}$; c: $\frac{\pi}{4}$, $\frac{5\pi}{4}$; d: $\frac{3\pi}{4}$, $\frac{7\pi}{4}$

12-126. sine and cosine: domain: all real numbers, range: $-1 \le y \le 1$
tangent: domain: all real numbers except $x \ne \frac{\pi}{2} + \pi n$, range: all real numbers

12-127. a: ellipse, $\frac{(x+2)^2}{8} + \frac{(y-3)^2}{12} = 1$, (–2, 3) b: circle, $(x+2)^2 + (y-2)^2 = \frac{5}{2}$, (–2, 2)





12-128. a: $\frac{5}{42}$, b: $\frac{5}{14}$

12-129. Calculate the sums of two geometric series, the first with 25 terms, the second with 15. Retirement at age 55: \$1,093,777; at age 65: \$1,115,934.

12-130. a: 20 meters, b: $20 + 20(0.6) + \ldots + 20(0.6)^{14}$, c: 49.976 meters

12-131. \$20,000 at 8% and \$30,000 at 6.5%

12-132. a: $\sqrt{3}$, b: $\sqrt{3}$, c: The answers are the same since $\tan\theta = \frac{\sin\theta}{\cos\theta}$.

12-133. a: 0; b: undefined; c: 0; d: undefined; e: 0; f: 0;
g: When the cosine is 1 (at 0, π, 2π, and 4π), you get the x-intercepts. When the cosine is 0 (at $\frac{\pi}{2}$ and $\frac{3\pi}{2}$), the tangent is undefined and asymptotes occur at these locations.

12-134. 55°

12-135. (8, –3)

12-136. $y = 8(1.5)^x - 10$

12-137. $5 = \frac{1(3+7)}{2}$; $\frac{k(3k+7)}{2} + 3k + 5 = \frac{3k^2+13k+10}{2} = \frac{(k+1)(3k+10)}{2}$, the sum of k+1 terms.

Lesson 12.3.2

12-144. **500 miles**

12-145. **1**

12-146. **When $|r| \geq 1$, r^n increases in size as n increases, so the expression $1 - r^n$ does not get close to 1, and being able to replace that expression with 1 is a key part of the derivation of the formula.**

12-147. $\frac{121}{27}$

12-148. **a: –9, 2; b:** $\frac{5}{2}$

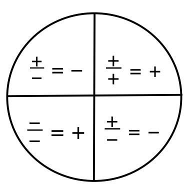
12-149. **a: See values in table at right.**
b: Answers vary.
c: 13; Explanations vary.

x	$f(x)$
1	**0**
2	0.2702
3	0.4283
4	**0.5404**
5	0.6275
6	**0.6985**
7	0.7587
8	**0.8106**
9	**0.8566**
10	**0.8977**
11	0.9349

12-150. **a:** $-1+9i$, **b:** $26+7i$, **c:** $-\frac{14}{25}+\frac{23}{25}i$, **d:** $-21+20i$

12-151. $\frac{\pi}{2}$ **and** $\frac{3\pi}{2}$ **or whenever** $\cos\theta = 0$

12-152.



$\tan\theta = \left(\frac{\sin\theta}{\cos\theta}\right)$

12-153. **When $n=1$, $1^2=1$. If $n=k+1$, then $1+3+5+\ldots+2(k+1)-1=(k+1)^2$. Start with $1+3+5+\ldots+k=k^2$. Add $2(k+1)-1$ to both sides to get $1+3+5+\ldots+k+2(k+1)-1=k^2+2(k+1)-1$. The right side simplifies to $k^2+2k+1=(k+1)^2$. The result shows that when the formula works for k, it works for $k+1$.**

12-154. ${}_{500}C_3 = 20,708,500$

Lesson 12.4.1

12-161. $x^7+7x^6y+21x^5y^2+35x^4y^3+35x^3y^4+21x^2y^5+7xy^6+y^7$

12-162. $8x^3-36x^2+54x-27$

12-163. $-640w^2z^3$

12-164. **5461 people**

12-165. a: 16; b: Not possible, because $r > 1$ and the terms keep increasing.

12-166. a: 1; b: $(x-1)$; c: 1, $\frac{-1\pm\sqrt{5}}{2}$

12-167. a: 1, b: ±2

12-168. Sample answer: The tangent is the ratio of the sine over the cosine. It also can be seen as the slope of a line. When the cosine equals 0, the tangent is undefined.

12-169. a: shifted up 1 unit, b: shifted left $\frac{\pi}{4}$, c: flipped vertically, d: vertically stretched by a factor of 4

12-170. a: $\frac{1}{1-x}$, b: $1+x+x^2+x^3 \ldots$

Lesson 12.4.2

12-180. ${}_5C_2\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^3 = \frac{5}{16}$

12-181. $42x^3$

12-182. 728

12-183. $81x^4 + 108x^3 + 54x^2 + 12x + 1$

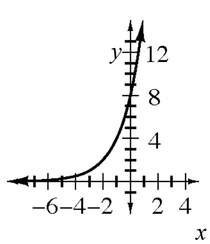
12-184. Substitute $a = 1$ and $b = 1$ into the formula.

12-185. 2, –1

12-186. $\frac{x^2 y}{y-5x^2}$

12-187. a: yes; b: yes; c: Any reasonable explanation is okay. The numbers on the left represent all the ways to choose n or fewer things out of n. The number on the right represents a decision chart with n decisions to be made where each item is either chosen or not.

12-188.



$y = 2^{(x-1)} - 5$

12-189. $\frac{{}_nP_r}{r!} = \frac{\frac{n!}{(n-r)!}}{r!} = \frac{n!}{(n-r)!\,r!}$

12-190. $158,184,000 - 17,576,000 = 140,608,000$; $\frac{1}{175760}$

Lesson 12.5.1

12-194. **Robin: \$11,887.58; Tyrell: \$11,815.60; difference: \$71.98**

12-195. **a:** $1+\frac{3}{n}+\frac{3}{n^2}+\frac{1}{n^3}$, **b:** $1+\frac{5}{n}+\frac{10}{n^2}+\frac{10}{n^3}+\frac{5}{n^4}+\frac{1}{n^5}$

12-196. **Use the Multiplicative Identity** $1=\frac{yz}{yz}$**, use the Commutative and Associative Properties to reorganize the numerator as** $y(1-\frac{5}{y})z(3+\frac{2}{z})$**, and then use the Distributive Property to write the numerator as** $(y-5)(3z+2)$.

12-197. **In each case multiply by a fraction, for a: use** $\frac{1/a^2}{1/a^2}$**, for b: use** $\frac{1/x^3}{1/x^3}$**, for c: use** $\frac{1/n^2}{1/n^2}$**, for d: use** $\frac{1/n^3}{1/n^3}$**. Use the Associative and Commutative Properties to rearrange the numerator and then the Distributive Property to combine factors. Finally use the Multiplicative Identity to simplify within the factors.**

12-198. **a: 14.7 lbs./sq. in., b: 11.96 ft./sq. in., c: about 14.86 lbs./sq. in.**

12-199. **a:** $-\frac{b}{a}$, **b:** $\frac{c}{a}$, **c: The sum is the opposite of the coefficient of** x **divided by the coefficient of** x^2**; d: The product is the constant divided by the coefficient of** x^2.

12-200. **a:** $x^2+6x+34=0$, **b:** $x^2-x+1=0$, **c:** $x^2-14x+46=0$, **d:** $x^2-x-42=0$, **e:** $12x^2-x-6=0$

Lesson 12.5.2

12-206. **a: 9.00646832 for both**
b: 3.10628372 for both
c: It will take about 9 years to double.
d: After about three years and one month, the car will be worth less than half the original price.

12-207. **Because the base of the natural logs is *e*, *e* is between 2 and 3, and** $\ln e=1$; $x=e$.

12-208. **a: 2.1972, b: 2.89035, c: 2.7726, d: –1.0986**

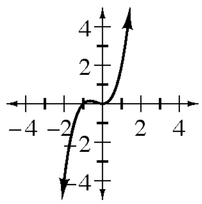
12-209. **a:** $x=10p$, **b:** $x=3q-2p$

12-210. **a:** $2=(1.015)^{4t}$, $2=e^{0.06t}$; **b: quarterly, 11.64 years, continuously, 11.55 years; c: The difference is about one month, so probably not.**

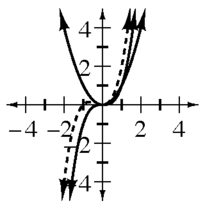
12-211. **a:** $10t+u$, **b:** $10u+t$, **c:** $t+u=11$ **and** $10t+u-(10u+t)=27$, **d: 74 and 47**

12-212. **27 nickels, 42 dimes, and 61 quarters**

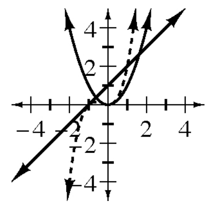
12-213. graph:



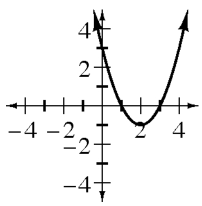
a: "add" two graphs, point by point, by adding the y-values.



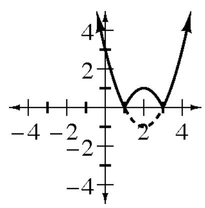
b: "multiply" the two graphs, point by point, by multiplying the y-coordinates



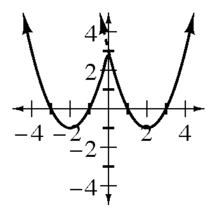
12-214.



a:



b:



c: For part (a), the parts above the x-axis stay the same, and the parts below the x-axis are reflected upward across the axis. For part (b), the part of the graph right of the y-axis remains the same, and the part left of the y-axis is replaced by a reflection of the part on the right of the axis.